

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES
IN RE APPLICATION MAIL STOP: APPEAL BRIEF
OF: AUER ET AL. CONFIRMATION No.: 4816
SERIAL No. 10/031,166 GROUP ART UNIT: 1621
FILED: JANUARY 17, 2002 EXAMINER: K. J. PUTTLITZ
FOR: CONTINUOUS PREPARATION OF METHYL FORMATE

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BRIEF ON APPEAL UNDER 37 C.F.R. §1.192

Sir:

This is an Appeal from the Examiner's action dated April 07, 2004, finally rejecting Claims 1 to 4. Claims 1 to 4 are currently pending.

REAL PARTY IN INTEREST:

The real party in interest is BASF Aktiengesellschaft, 67056 Ludwigshafen, Germany.

RELATED APPEALS AND INTERFERENCES:

To the best of the undersigned's knowledge, there are no related appeals or interferences within the meaning of 37 C.F.R. §1.192(c)(2).

STATUS OF THE CLAIMS:

The claims on appeal before the Board of Patent Appeals and Interferences are Claims 1 to 4. A copy of these claims is found in the attached Appendix.

STATUS OF THE AMENDMENTS:

Claims 5 to 9 which were held withdrawn from consideration by the Examiner have been canceled by appellants in a supplemental submission of even date with this paper. No further amendments have been filed in this application after final rejection.

SUMMARY OF THE INVENTION:

Appellants' invention as defined in Claim 1 and further specified in Claims 2 to 4 relates to a process for preparing methyl formate

- (a) by reacting excess methanol with carbon monoxide under superatmospheric pressure at elevated temperature in the presence of an alkali metal methoxide or alkaline earth metal methoxide as catalyst to form methyl formate, and
- (b) by separating the methyl formate formed from the reaction product, and recirculating the liquid phase which is essentially free of methyl formate to the reactor, with part of the liquid phase to be recirculated being discharged and fresh catalyst solution being fed in.

According to appellants' invention, a number of particular provisions apply to the conversion summarized in (a) and to the procedure summarized in (b). With regard to the conversion (a), appellants' Claim 1 specifically requires that the reaction be conducted

- 1) in a reactor cascade comprising at least two reactor elements,
- 2) at from 80 to 120°C,
- 3) under a carbon monoxide pressure of from 90 to 180 bar,
- 4) in the presence of from 0.05 to 0.5% by weight, based on the weight of the liquid feed, of the catalyst, and
- 5) that the molar ratio of carbon monoxide to methanol be set to from 3:1 to 0.5:1.

Additionally, and with a view to the procedure (b), appellants' invention as defined in Claim 1 requires

- 6) that the reaction mixture which is obtained in (a) be passed to a distilling apparatus in which essentially the methyl formate is stripped from the reaction mixture;
- 7) that a part TR of from 80 to 20% of the remaining liquid phase be recirculated to the reactor;

- 8) that a part TA of the remaining liquid phase be discharged to a desalting apparatus where residual catalyst and catalyst degradation products are removed solids-free from the discharged part TA, and
- 9) that the remaining methanol is returned directly or indirectly to the reactor.

Appellants have found that the combination of requirements makes it possible to achieve a high conversion of carbon monoxide¹⁾ at low catalyst concentrations²⁾. As pointed out by appellants, the low catalyst concentration reduces the expenditure incurred in starting materials, and the moderate synthesis pressure avoids the expenditure incurred in high-pressure plants³⁾. Moreover, the specific combination of requirements which characterizes appellants' process provides that a high space-time yield of from 400 to over 1000 kg/m³/h of methyl formate is achieved, and that a final methyl formate concentrations of more than 80% by weight in the reaction mixture is reached⁴⁾. At the same time, appellants' process avoids the formation of precipitates and the problems and down-times of the production plant which are associated with blockages caused by precipitates⁵⁾.

ISSUE(S) PRESENTED:

- I. Whether the Examiner erred finding that the subject matter of appellants' Claims 1 to 4 was indefinite under the provisions of 35 U.S.C. §112, ¶2.
- II. Whether the Examiner erred finding that the subject matter of appellants' Claims 1 to 4 was *prima facie* obvious under 35 U.S.C. §103(a) in light of the disclosure of *Chang et al.* (US 4,661,624).

GROUPING OF THE CLAIMS:

For the issue(s) above it is affirmed that Claims 2 to 4 stand and fall with Claim 1.

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- 1) Cf. page 14, indicated lines 19 to 21, of the application.
 - 2) Cf. page 12, indicated lines 13 to 21, of the application.
 - 3) Cf. page 19, indicated lines 10 to 12, of the application.
 - 4) Cf. page 19, indicated lines 7 to 9, of the application.
 - 5) Cf. page 19, indicated lines 12 to 15, of the application.

A R G U M E N T S

I. For the following reasons, the Examiner's finding that the subject matter of appellants' Claims 1 to 4 was indefinite under the provisions of 35 U.S.C. §112, ¶2, is deemed to be in error.

The Examiner argues that appellants' claims are indefinite within the meaning of Section 112, ¶2, because "the abbreviations TR and TA in claim 1 are confusing because it is unclear what these abbreviations are referring to"⁶). Appellants' Claim 1 recites the wording

... a part TR of from 80 to 20% of the remaining liquid phase is recirculated to the reactor and a part TA is discharged, ...

(emphasis added)⁷). As such, it is immediately apparent from the wording of appellants' Claim 1 that "TR" and "TA" are designations which are used to distinguish the "part TR", cf. the part of the remaining liquid which is recirculated, and the "part TA", cf. the part of the remaining liquid which is discharged. Contrary to the Examiner's position it is deemed to be immediately apparent to a person of ordinary skill in the art that the designation TR is used to specify the part of the remaining liquid which is recirculated, and that the designation TA is used to specify the part of the remaining liquid which is discharged.

Moreover, the "distinctly claim" requirement of Section 112, ¶2, means that the claims must have a clear and definite meaning when construed in the light of the complete patent document⁸), and the test of definiteness is whether one skilled in the art would understand the meets and bounds of the claim when reading it in the light of the specification⁹). A person of ordinary skill in the art who considers appellants' Claim 1 in light of the supporting disclosure finds on page 10, indicated line 21 et seq., of the application:

... *a part TR of the remaining liquid phase is recirculated to the reactor and a part TA is discharged, ...*

The first paragraph on page 16 of the application correspondingly

6) Office action dated September 10, 2003, page 5, lines 7 to 10, and Office action dated April 07, 2004, page 2, lines 13 to 16.

7) Claim 3 correspondingly refers to "the discharged part TA".

8) Cf. Standard Oil Co. v. American Cyanamid Co., 774 F.2d 448, 227 USPQ 293 (CAFC 1985).

9) Cf. Morton Int. Inc. v. Cardinal Chem. Co., 5 F.3d 1464, 28 USPQ2d 1190 (CAFC 1993); Orthokinetics Inc. v. Safety Travel Chairs, Inc., 806 F.2d 1565, 1 USPQ2d 1081 (CAFC 1986).

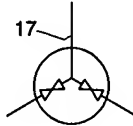
explains:

... This solution is divided into a part TR which is recirculated straight back to the reactor cascade and a part TA which is discharged from the circuit. ...

The division of the requisite solution into a part TR and a part TA is further shown in the figure which illustrates appellants' process, and the respective part of the figure is addressed on page 23 indicated lines 20 to 23, of the application, which refers to

... an adjustable stream divider (18) for dividing the methanol stream [(17)] containing residual catalyst and catalyst degradation products leaving the distillation apparatus into the substreams TR and TA, ...

The stream divider (18) of appellants' figure which is addressed in the recited statement of the application is reproduced below:



A person of ordinary skill in the art who reads appellants' claims in light of the supporting disclosure is, therefore, immediately apprised that the requisite stream of the remaining liquid phase is split or divided into substreams, one of which is recirculated to the reactor cascade and the other one of which is discharged. Appellants' designation of the recirculated part of the requisite stream as "TR" and of the discharged part of the stream as "TA" can in no way be considered to confuse a person of ordinary skill to an extent where the subject matter of appellants' claims is rendered indefinite within the meaning of Section 112, ¶2. "In rejecting a claim under the second paragraph of 35 U.S.C. 112, it is incumbent on the examiner to establish that one of ordinary skill in the pertinent art, when reading the claims in light of the supporting specification, would not have been able to ascertain with reasonable degree of precision and particularity the particular area set out and circumscribed by the claims"¹⁰). The Examiner's statement that "the abbreviations TR and TA in claim 1 are confusing because it is unclear what these abbreviations are referring to" clearly fails to provide an argument which establishes that one of skill in the art is unable to ascertain the particular area set out and circumscribed in the claim when reading the claim alone or in light of the disclosure.

10) Cf. Ex parte Wu, 10 USPQ2d 2031 at 2033 (BPAI 1989), emphasis added.

II. For the following reasons, the Examiner's finding that the subject matter of appellants' Claims 1 to 4 was prima facie obvious under 35 U.S.C. §103(a) in light of the disclosure of Chang et al. (US 4,661,624) is deemed to be in error.

The Examiner asserts that the difference between appellants' process and the process taught by *Chang et al.* resides in the fact that *Chang et al.* fail to specifically state that a TR:TA split is controlled as a function of the alkali metal and earth alkali metal formate content so that solid precipitates are prevented¹¹⁾.

With regard to appellants' requirements pertaining to the reaction conditions¹²⁾ the Examiner points to col. 3, indicated lines 10 to 29, of *US 4,661,624* as providing for a process for synthesizing alkyl formates such as methyl formate in a liquid phase by reacting a lower alcohol such as methanol with a CO containing gas "at relatively high CO partial pressures" and moderate temperatures in the presence of "relatively high concentrations" of a catalyst¹³⁾, and points to col. 1, indicated lines 40 to 43, of *US 4,661,624* for showing that the prior art addressed by *Chang et al.* utilizes low concentrations of catalyst¹⁴⁾.

The disclosure of *Chang et al.* in col. 3, indicated lines 10 to 29, of *US 4,661,624* does not provide information pertaining to the requirements of appellants' process which are designated as (2) to (5) in the foregoing¹⁵⁾.

- *Chang et al.* teach in col. 2, indicated line 52, of *US 4,661,624*, that the CO is employed at a pressure from 70 to 1000 pisa, corresponding to from 4.8 to 68.9 bar. In contrast to the process of *Chang et al.* appellants' Claim 1 requires a carbon monoxide pressure of from 90 to 120 bar.

- *Chang et al.* teach in col. 2, indicated line 53, and in col. 3, indicated line 47, of *US 4,661,624*, that the catalyst is to be

11) Cf. page 9, lines 1 to 4, of the Office action dated September 10, 2003; page 5, lines 7 to 10, of the Office action dated April 07, 2004. The particularities of appellants' TR:TA split are addressed on page 16, indicated lines 1 to 14, of the application.

12) Cf. appellants' requirements enumerated as (1) to (5) in the "Summary of the Invention" on page 2 of this paper.

13) Cf. page 7, lines 4 to 13, of the Office action dated September 10, 2003; page 3, line 19, to page 4, line 4, of the Office action dated April 07, 2004.

14) Cf. page 6, lines 13 to 16, of the Office action dated April 07, 2004; page 2 of the Advisory action dated July 28, 2004.

15) Cf. page 2 of this paper.

employed in a concentration of from 1 to 8 mole %, corresponding to from about 1.7 to 12.8% by weight¹⁶⁾. In contrast to the process of *Chang et al.* appellants' Claim 1 requires a catalyst concentration of from 0.05 to 0.5% by weight.

The Examiner asserts that the teaching of *Chang et al.* provides for carrying out the reaction in a reactor cascade and that the figure of *Chang et al.* illustrates a reactor cascade comprising two reactors¹⁷⁾. However, every cascade configuration of reactors is characterized in that the matter streams which are introduced into a first vessel of the cascade pass through all of the reactors which form the cascade before the reaction is terminated by withdrawing the reaction mixture and passing it to work-up¹⁸⁾. Two basic cascade arrangements are possible, namely a co-current arrangement and a counter-current arrangement:

- In a *co-current* arrangement, the starting materials -including solvents and the like- are introduced into the first reactor of the cascade. The content of the first reactor, ie. a "reaction mixture" of all remaining starting materials and any reaction product formed, is conveyed to the next reactor of the cascade for further reaction and so forth until the reaction mixture reaches the last reactor of the reactor cascade. Once the reaction mixture has reached the last reactor of the reactor cascade, the reaction is terminated by withdrawing the reaction mixture and passing it to work-up.

- In a *counter-current* arrangement, gaseous starting materials are introduced into the last reactor of the reactor cascade whereas liquid starting materials are introduced into the first reactor of the reactor cascade. Here, the liquid reaction mixture is passed in toto from one reactor to the next for further reaction until the last reactor of the cascade is reached, and gaseous components are passed in toto from one reactor to the next until the first reactor of the cascade is reached. Once the reaction mixture has reached the last

16) According to *Chang et al.*'s comments in col. 1, indicated lines 40 to 43, and in col. 2, indicated lines 10 to 23, of *US 4,661,624*, the high catalyst concentrations are necessary to achieve high reaction rates, and low catalyst concentrations are undesirable because they result in a slow reaction, require prolonged residence times and substantially increase the equipment costs.

17) Cf. page 7, lines 14 and 15, of the Office action dated September 10, 2003; page 4, lines 5 and 6, of the Office action dated April 07, 2004.

18) The more detailed explanations given in appellants' reply dated July 07, 2004, and the illustrative text book copies provided with that reply are herewith incorporated by reference.

reactor of the reactor cascade, the reaction is terminated by withdrawing the reaction mixture and passing it to work-up. Any gaseous components which remain after reaching the first reactor of the reactor cascade are then, correspondingly, withdrawn from the first reactor.

When reactors are used in a cascade configuration, the reaction is terminated by withdrawing the reaction mixture from the reactor cascade only after the reaction mixture has passed through all of the reactors of the cascade.

The reactor configuration which is illustrated in the figure of *Chang et al.* is not a cascade configuration as the Examiner would have it because the reaction mixture of methyl formate and methanol which is formed in primary reaction zone (12) is passed directly to work-up in the distillation zone (22) without passing through the secondary reaction zone (18). Correspondingly, the reaction mixture of methyl formate and methanol which is formed in secondary reaction zone (18) is passed directly to work-up in the distillation zone (22) without passing through the primary reaction zone (12).

In light of the foregoing, appellants' process differs from the process taught by *Chang et al.* in at least the following aspects:

- i) the carbon monoxide pressure which is employed;
- ii) the catalyst concentration in the liquid feed; and
- iii) the reactor configuration which is used for the reaction.

It is well settled that obviousness within the meaning of Section 103(a) requires more than the mere possibility to modify a prior art teaching in the manner which is necessary to arrive at the claimed invention. For obviousness under Section 103(a) it is also necessary that the prior art provide some teaching or suggestion which would motivate a person of ordinary skill in the art to do what the applicant has done¹⁹⁾. The teaching of *Chang et al.* at least fails to motivate a person of ordinary skill to adapt the carbon monoxide pressure in the manner necessary to arrive at the pressure employed in accordance with appellants' invention, and to motivate a person of ordinary skill to conduct the reaction a reactor cascade.

Moreover, the disclosure of *Chang et al.* cannot be deemed to motivate a person of ordinary skill in the art to adapt the catalyst

19) Cf. *In re Fritch*, 972 F.2d 1260, 23 USPQ2d 1780 (CAFC 1992); *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438, 1442 (CAFC 1991); *In re Gordon*, 733 F.2d 900, 902, 221 USPQ 1125, 1127 (CAFC 1984).

concentration in the manner necessary to arrive at the concentrations employed in appellants' process. In col. 1, indicated lines 40 to 43, of *US 4,661,624, Chang et al.* specifically address the disadvantages which arise when the catalyst concentration in the feed is low. Additionally, *Chang et al.* point out that the requisite disadvantages are avoided when the feed contains the catalyst in high concentrations²⁰). Accordingly, a person of ordinary skill in the art had no incentive whatsoever to make the requisite modification.

With regard to the requirements (7) to (9) of appellants' process the Examiner refers to *Chang et al.*'s disclosure in col. 4, indicated lines 10 to 20, of *US 4,661,624*, which provides that the liquid phase recovered at the bottom of the distillation zone (22) of *Chang et al.*'s process is recycled to reactors (12) and (18), and asserts -referring to Claim 4- that catalyst desalting is integral in element (22) of *Chang et al.*²¹). Claim 4 of *Chang et al.* reads

A process as claimed in claim 1 wherein the CO containing stream is a purified coal or heavy residual oil gasification stream.

and clearly fails to support the Examiner's assertion. Moreover, there is nothing in the teaching of *Chang et al.* which suggests or implies that the distillation zone (22) has "desalting" capacity. The Examiner also refers in this context to the statements of *Chang et al.* in col. 5, indicated lines 35 to 48, of *US 4,661,624*²²). However, the respective section merely provides that harmful precipitation does not occur in spite of the high catalyst concentrations. As such, the respective statements of *Chang et al.* are not related to a desalting procedure and cannot be deemed to motivate a person of ordinary skill to employ a desalting stage.

In accordance with the disclosure and illustration of *Chang et al.*, essentially pure methanol is recovered from the bottom of the distillation zone (22) through line (26)²³), and a stream (34) of the recycled methanol which contains catalyst is removed, while -downstream from line (34)- fresh catalyst is introduced into the methanol stream through line (36) to maintain the desired catalyst activity. The fate of the stream (34) is not further addressed by *Chang et al.*

20) Cf. col. 2, indicated lines 10 to 23, of *US 4,661,624*.

21) Cf. page 8 of the Office action dated September 10, 2003; page 4, line 7, to page 5, line 6, of the Office action dated April 07, 2004.

22) Cf. page 9, lines 6 to 13, of the Office action dated September 10, 2003; page 5, lines 11 to 19, of the Office action dated April 07, 2004.

23) Col. 5, indicated lines 3 et seq., of *US 4,661,624*.

As such, the disclosure of *Chang et al.* is silent with regard to the requirements (7) to (9) of appellants' process.

In light of the foregoing, appellants' process differs from the process taught by *Chang et al.* not only in particular aspects relating to the conditions of the reaction in which methyl formate is formed but also differs significantly in procedural aspects. More pertinently, the disclosure of *Chang et al.* fails to provide for some teaching or suggestion which would have motivated a person of ordinary skill in the art to make all of the changes which are necessary to arrive at appellants' process. As such, the disclosure of *Chang et al.* cannot be deemed to render appellants' process obvious within the meaning of 35 U.S.C. §103(a).

C O N C L U S I O N

For the foregoing reasons, appellants respectfully urge that the Examiner erred finding that appellants' Claims 1 to 4

- fail to meet the requirements of 35 U.S.C. §112, ¶2, and
- are unpatentable under the provisions of 35 U.S.C. §103(a) in light of the teaching of *Chang et al.*

It is respectfully requested that the Examiner's respective rejections be reversed. Favorable action is solicited.

Please charge any shortage in fees due in connection with the filing of this paper, including Extension of Time fees, to Deposit Account No. 11.0345. Please credit any excess fees to such deposit account.

Respectfully submitted,

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Encl.: THE CLAIMS ON APPEAL (Appendix)

HBK/BAS

A P P E N D I X

THE CLAIMS ON APPEAL:

1. A process for preparing methyl formate by reacting excess methanol with carbon monoxide under superatmospheric pressure and at elevated temperature in the presence of alkali metal methoxide or alkaline earth metal methoxide as catalyst in a pressure-rated reactor, separating the methyl formate formed from the reaction product and recirculating the liquid phase which is essentially free of methyl formate to the reactor, with part of the liquid phase to be recirculated being discharged and fresh catalyst solution being fed in, wherein

the reaction is carried out in a cascade comprising at least two reactor elements

at from 80 to 120°C,

under a carbon monoxide pressure of from 90 to 180 bar,

in the presence of from 0.05 to 0.5% by weight, based on the weight of the liquid feed, of an alkali metal alkoxide or alkaline earth metal alkoxide,

the molar ratio of carbon monoxide to methanol is set from 3:1 to 0.5:1, whereby at least that amount of methanol required to keep both the catalyst used and its degradation products virtually completely dissolved under the reaction conditions in the reactor and in the fresh reaction product remains unreacted,

the total output from the reactor is passed to a distilling apparatus in which essentially the methyl formate is stripped from the reaction mixture,

a part TR of from 80 to 20% of the remaining liquid phase is recirculated to the reactor and a part TA is discharged,

and residual catalyst and catalyst degradation products are removed solids-free from the discharged part in a desalting apparatus and the remaining methanol is returned directly or indirectly to the reactor.

2. A process as claimed in claim 1 carried out using from 2 to 5 reactor elements.
3. A process as claimed in claim 1, wherein steam and/or hot water and, if desired, additional heat are fed to the discharged part TA of the liquid phase remaining after separating off the methyl

formate, consisting essentially of methanol containing catalyst and catalyst degradation products, in the desalting apparatus in such amounts that the methanol is essentially completely vaporized and an aqueous solution of the catalyst degradation products is obtained.

4. A process as claimed in claim 1, wherein the desalting apparatus is operated as an integrated heat system with the distillation apparatus and the methanol vapor leaving the top of the desalting apparatus is fed to the distillation apparatus.